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ABSTRACT

The instructional information system (IIS), a method by which instructionally relevant information can be collected, stored, processed, and reported to various users in a timely manner, has considerable potential to improve instruction. To better identify the circumstances in which the IIS will succeed, it is necessary to know more about how teachers make decisions and how they would use information provided by instructional information systems. The experiences of the Sheboygan Area School District are examined to provide insight on these problems. Literature is reviewed; major questions are conceptualized; preliminary observations on teachers' needs for information and the impact of information on instruction are presented; four routine instructional decisions are examined, and instructional decisions which could be supported by information systems are identified; problems posed by implementing instructional information systems are discussed; and goals for implementing an instructional information system are presented. A bibliography is provided. (KM)

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PROBLEMS IN TEACHERS' USE OF INSTRUCTIONAL INFORMATION SYSTEMS

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ABSTRACT

The use of computers to test students, track achievement and record various measures of schooling has increased rapidly in the past few years. Inexpensive computer hardware is now more widely available to schools, more powerful and flexible software is being developed or adapted, and the skills of school personnel are being enhanced. The potential for information systems to improve instruction may be unrealized unless we better understand the information needs of teachers and principals. We need to know what types of information are useful to instruction, what are the information needs of different instructional approaches and forms of school organization, and what effect does unlimited information have on instruction. Most important, however, is the need to know if objective information can have sufficient impact on instruction to make it worth the investment.

This paper reviews the literature, conceptualizes some of the major questions and presents some preliminary observations on teachers' need for information and the impact of information on instruction. It identifies the instructional decisions which could be supported by information systems, briefly reviews some literature on how instructional decisions are made at the classroom level, and identifies problems posed by the implementation of instructional information systems.

Problems In Teachers' Use of
Instructional Information Systems

I. STATEMENT OF THE PROBLEM

The use of computers to test students, track achievement and record various measures of schooling has increased rapidly in the past few years. Inexpensive computer hardware is now more widely available to schools, more powerful and flexible software is being developed or adapted, and the skills of school personnel are being enhanced. Schools are trying to make better use of existing data and find new ways to create data bases. The result is that schools are exploring some of the information technologies which have made other organizations more efficient and effective.

Modern information systems have vast potential for improving instruction. This potential may be unrealized unless we better understand the information needs of teachers and principals. We need to know what types of information are useful to instruction, what are the information needs of different instructional approaches and forms of school organization, and what effect does unlimited information have on instruction. Most important, however, is the need to know if objective information can have sufficient impact on instruction to make it worth the investment.

One technology, with notable potential, is the instructional information system (IIS). An instructional information system is a method by which instructionally relevant information can be collected, stored, processed, and reported to various users in a timely manner. Such information, stored on a computer, can be used by several people to provide better, more precise, and timely information to support and manage the instructional system at the classroom, building, and district levels.

The assumption which prompts the development of an IIS is that more (and better) information about students will improve instruction. Experience to date has shown that this is not necessarily so. IIS's have considerable potential to improve instruction, but not by themselves and not in every circumstance. To better identify the circumstances in which they will succeed, we need to know more about how teachers make decisions and how they would use information provided by instructional information systems. This paper wiil review the experiences of the Sheboygan Area School District to provide insight on these problems.

This paper will review the literature, conceptualize some of the major questions and present some preliminary observations on teachers' needs for information and the impact of information on instruction. It will identify the instructional decisions which could be supported by information systems, briefly review some literature on how instructional decisions are made at the

classroom level, and identify problems posed by implementing instructional information systems.

II. ANALYSIS OF INSTRUCTIONAL DECISION MAKING

The purpose of this section is to look at some instructional decisions that teachers routinely make and tasks they most often perform, which are based on those decisions. Where possible, it will look at the information used in those decisions under circumstances most often found in schools and discuss the potential impact of using instructional information systems to help in those decisions. Four decisions will be reviewed.

A. Decision 1: Deciding What To Teach

Deciding what to teach involves selecting the objectives to teach, and selecting and organizing learning activities.[1] The need to select objectives is dependent upon how much the teacher teaches towards objectives, how specific the textbook and curriculum are about objectives, and how much the teacher's supervisor stresses teaching towards objectives. Macdonald[2] and Eisner[3] argue that teachers do

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[1]Christopher M. Clark and Robert J. Yinger, "Teacher Thinking," in Penelope L. Peterson and Herbert J. Walberg (eds.), Research on Teaching: Concepts, Findings, and Implications (Berkeley: McCutchan Publishing Co., 1979), p. 233.

[2]James B. Macdonald, "Myths about Instruction," Educational

(Footnote continued)

not begin their planning by thinking about objectives and then proceed to deciding which activities will teach students the content defined by an objective. Rather, they decide on learning activities that have worked in the past and then try to work them into an objective based format.

Instructional information systems can reinforce and support teaching to objectives by providing information organized by curriculum objectives. The following activities can be organized by objective: Reporting test scores; recommending curriculum sequencing; organizing data bases on methods and materials; and grouping, pacing, and grading of students. Thus, if the information system provides any support to teachers at all, it provides it under the objective based organizational scheme.

B. Decision 2: Deciding How To Teach Students With Different Needs and Levels of Achievement by Prescribing Adjustments in Teaching Approach and Content

Prescriptive instruction has been shown to be an effective method of instruction, particularly in basic skills.[4] Many

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[2](continued)
Leadership (1965), Vol. 22, pp. 571-6.

[3]Elliot W. Eisner, "Educational Objectives: Help or Hindrance," School Review (1967), Vol. 75, pp. 250-66.

[4]Benjamin S. Bloom, Human Characteristics and School Learning (New York: McGraw-Hill, 1976); Robert Glaser, Adaptive Education: Individual Diversity and Learning (New York: Holt, Rinehart and Winston, 1977); and B. V. Rosenshine, "Content, Time and Direct Instruction," in Peterson and Walberg, op. cit., pp. 28-56.

prescriptive instruction systems use flexible grouping and instructional team organization to optimize the use of teacher and student talents, time, and, other educational resources.[5] Decisions on teaching to individual differences depends upon the motivation of the teacher and the support that the teacher receives. Instructional information systems can aid teachers by storing curriculum sequences and prompting the teacher with the next objective in the sequence to help plan pacing decisions. IIS's can support teachers by storing and dynamically forming and re-forming groups of students, providing recommendations on grouping and pacing to teachers and administrators, and providing information on student achievement to guide remediation or enrichment. An instructional information system can make that process easier by more specifically identifying student needs.

The system can report deficiencies by individuals or groups and give an indication of what needs to be taught again with different emphasis, and can provide a comprehensive listing of materials, activities and other resources to support the instructional process.

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[5]Margaret C. Wang, "Adaptive Instruction: Building on Diversity," Theory into Practice (1980), Vol. 19, No. 2, pp. 122-28; and Margaret C. Wang and Rita Catalano, The Adaptive Learning Environments Model: An Overview (Pittsburgh, Pa.: University of Pittsburgh, Learning Research and Developmemt Center, 1981).

Although they are not needed in many curricula, the system ought to have the capacity to store prerequisites to various skills. This is crucial for some mastery learning techniques where assignment to a group is dependent upon mastery of the prerequisite skills. These curricula

> ...include a sequence of learning hierarchies and criterion-referenced tests that provides teachers with information on student mastery competencies, and, thereby, ensures each student's placement at an appropriate point in the learning sequence. Thus, students neither repeat tasks they already have mastered nor work on objectives for which they lack prerequisite skills. In addition, the diagnostic-prescriptive process includes small steps in the learning hierarchies to encourage predominently successful classroom experiences, even for those students who initially are the least able.[6]

There is considerable evidence that teachers rarely use objective or systematically collected information to make instructional decisions. Shavelson and Stern,[7] in their

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[6]Margaret C. Wang and Herbert J. Walberg, "Adaptive Instruction and Classroom Time," American Educational Research Journal (Winter, 1983), Vol. 20, No. 4, p. 605-6. Also see, Loren B. Resnick, Margaret C. Wang and J. Kaplan, "Behavioral Analysis in Curriculum Design: A Hierarchically Sequenced Introductory Mathematics Curriculum," The Journal of Applied Behavior and Analysis (1973), Vol. 6, No 4, pp. 679-710; and Margaret C. Wang, "Development and Consequences of Students' Sense of Personal Control, in J. Levine and Margaret C. Wang, (eds.), Teacher and Student Perceptions: Implications for Learning (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1983).

[7]Richard J. Shavelson and Paula Stern, "Research on Teachers' Pedagogical Thoughts, Judgments, Decisions and Behavior," Review of Educational Research (Winter, 1981), Vol. 51, No. 4, pp. 462-5.

study of instructional decision making, looked at the type of information on students which teachers attended to in planning and carrying out instruction. They summarized the findings of 33 studies and categorized the types of decisions made with the types of information ("salient cues" in Shavelson and Stern's terminolgy) used for making decisions. Most of the information that teachers reported using for decision making were perceptions of student motivation, other affective traits and generalized "ability." Of the 33 studies, in only two did teachers mention tests, only one mentioned "achievement" and one mentioned "knowledge" or other non-cognitive skills as a source of information for instructional decisions. A review of these studies shows that, at least for reported information, teachers rarely used systematically gathered, objective information for decision making. Most of the information teachers use in the classroom for instructional decisions is based on personal observation and intuition.[8]

C. Decision 3: Deciding How to Record and Keep Track of Student Achievement

Instructional information systems can assist teachers in scoring objective referenced test and evaluating individual student performance. This function usually has the most direct impact on teachers in that it eases some laborious

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[8]Richard Shavelson and Hilda Borko, "Research on Teachers' Decisions in Planning Instruction," Educational Horizons (Summer 1979), pp. 184-5.

tasks of grading tests, keeping records and computing grades. Grades are entered through a keyboard or scanner. Access to the computer is with a terminal located as close as possible to the teacher's work area. The grading structure should have sufficient flexibility to be defined by the user. Grades may be in the typical "A, B, C . . ." terminology, a percent correct test score, a mastery or non-mastery symbol, or a raw score. Information follows the student, regardless of how the student is moved throughout the building or district. The teacher should have control over when and under what conditions the scores are either maintained, deleted, or updated. This function reduces the costs of "cumulative records" and can substantially increase the amount of detail contained in those records.

D. Decision 4: Selecting Activities and Materials for Both Individuals and Groups

Typically, teachers select activities based upon successes they have had in the past, their teaching style, and the entertainment value of the activities.

> Most teachers are trained to plan instruction by: (a) specifying (behavioral) objectives, (b) specifying students' entry behavior (knowledge and skills), (c) selecting and sequencing learning activities so as to move students from entry behavior to objectives, and (d) evaluating the outcomes of instruction in order to improve planning. While this prescriptive model of planning may be one of the most consistently taught features of the curriculum of teacher education programs, the model is consistently not

> used in teachers' planning in schools. Obviously there is a mismatch between the demands of classroom instruction and the prescriptive planning model. This mismatch arises because teachers must maintain the flow of activity during a lesson or face behavioral management problems. Hence, they are faced first and foremost with deciding what **activities** will engage students during the lesson or, put another way, the teacher must decide how to entertain his or her audience while attending to the curriculum. Activities, then, and not the prescriptive model are the focus of teacher planning.[9]

Most teachers are experienced in using intuitive rather than objective information and not at all experienced in sifting through large volumes of information, regardless of how much validity it might have, to make instructional decisions. To aid in the selection of activities and to provide greater assurance that the activities are linked to an instructional objective which is a component of the currriculum, instructional information systems can be set up to help teachers select activities. The record of test scores could be linked to a file containing the school resources, such as a portion of textbooks, specific review exercise, computer assisted instructional software or videotapes. A student who received a high score on a test would be directed to a set of enrichment activities, while a student who did poorly would be directed to remedial materials.

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[9]Shavelson & Stern, op.cit., p. 477.

D. General Observations about Instructional Decision Making

Teachers do not have the time to to go through a rational decision making process (where objectives or problems are identified, information is gathered, alternatives are ranked, values are reviewed, and decisions are made and monitored). The time needed for these kinds of activities is too great, and the benefits are too few for a teacher to invest in such a procedure. In the classroom, students need immediate attention and decisions about instruction must be made on the spot.[10] This immediacy has a direct impact on planning and the quality of instructional process.

In order to have an instructional information sysytem reduce the time needed for instructional decision making, the system would have to be well developed, extensive in scope, and convenient to the teacher or aides.

Many instructional decisions not made in the classroom, such as planning and evaluation, are generally accorded a low priority by teachers. Little on-the-job time is assigned for planning, few incentives are associated with planning, and teachers' are often disinclined to invest

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[10] Jackson, P. W., Life In Classrooms (New York: Holt, Rinehart and Winston, 1968).

time in planning, other than to identify and implement activities. Decisions on time allocations, grouping, pacing, activities, and methods are sometimes made for the teacher (by curriculum guides, curriculum specialists, textbooks, or principals) or by a teacher's standing personal practices.

It is obvious that teacher decision making is not systematic, does not rely on objective information, and is rarely directed toward the teaching of rationally derived instructional objectives. Generally, this is because objective information about achievement or other cognitive measures is usually not available to teachers. Even when it is available, information such as test scores is not current enough to be useful for instructional decisions; the organization of the information is not always correlated with the curriculum; the results are not always available in an easily usable format, and reports of results are written in the language of the statistician, not of the teacher. Testing and teaching are all too often separate and distinct activities, resulting in teachers having little ownership of, control over, or use for testing information.

It would seem that any attempt to get teachers to make greater use of more objective and systematic information would run a significant risk of failure from the start

because of the exigencies of instruction. In order to prompt a teacher to use objective and systematically gathered information for decision making, either the costs of acquiring and using the information must be low and/or the direct benefits to the instructional process of using that information must be increased. In some instances, reducing the costs of some portions of instructional decision making will allow teachers to perform some functions which they could not afford to do in the past.

III. PROBLEMS WITH INSTRUCTIONAL INFORMATION SYSTEMS

The last section discussed teacher decision making and the limited use that objective and systematic information plays in that decision making. The purpose of this section is to look at what problems teachers have in using objective information when available as part of an instructional information system.

There is a general resistance to technology in the classroom by some teachers, particularly when it systematizes activities in which teachers previously had considerable discretion. By their very nature, instructional information systems are systematic in how they treat information. This significantly changes the relationship of the curriculum to instruction. Previously, "curriculum" was treated casually by teachers. Teachers had considerable discretion in adapting and implementing the curriculum, particularly if a well organized textbook was not part

of the curriculum. Principals were not always well informed of the details of the curriculum, or were not always interested in monitoring strict adherence to the curriculum. Thus, teachers could adapt the curriculum to their own approach to instruction.

With the introduction of instructional information systems, the computer keeps better track of the student attainment of the skills embodied in the curriculum, regardless of how much "flexibility" is built into the system. Teachers perceive that they have less flexibility in adapting the curriculum; have less control over their teaching; are subject to more scrutiny by principals (who can more closely supervise adherence to the curriculum with less effort); are subject to more demands for accountability; and feel less trust as a professional.

Teachers don't automatically know how to use more information when it is provided by an instructional information system. When teachers have more objective information on students than they have had before, they will need considerable training and support in using that information to improve instruction. Merely better information does not automaticially improve instruction. It must be applied in a thoughtful and skillful manner.

The form of school organization seems to be a consideration in using this information. If there is a single teacher in a classroom, that teacher has less use for more information, regardless of how good, convenient, or illustrative that

information may be, because there are fewer instructional options available. For, example, there are distinct limits as to how much individualization the teacher can do. Since there is no need to share information, there is a high probability that much of the information will not be used. In contrast, in a team teaching situation, the decision to group students for instruction takes on greater meaning. In a single teacher classroom this decision is severely constrained by teachers' time, classroom space and the management of groups. In a multiple teacher environment, the decision is more complicated, with fewer constraints. In a team situation there is a greater need to share information, to maintain information in a consistent format, and to use information analytically.

The single teacher classroom organization is prevalent, in part, because it is a simple, easy to manage structure. Once students are assigned to a classroom (usually by grade level), the principal needs to make no additional management decisions on grouping and pacing of students. The teacher may be assisted by various specialists from time to time, but the responsibility for "managing" instruction is exclusively the teachers, with minimal help or interference from others. The teacher adapts and adopts district curriculum to personal teaching style and the perceived needs of the class. Unless there are problems with a student, the teacher or a district-wide concern, the principal does not intervene in the management of the classroom. Generally, no changes are made in student assignments and academic achievement

is not considered in the management scheme unless there is a major problem or the parents complain. Teachers are left to manage the class as best they can, even though other forms of organization might better utilize instructional resources and optimize learning.

The conclusion that might be drawn from this argument is that the effective utilization of information may be related to certain forms of school organization. These forms may have an effect on how much information and what kinds of information are useful. The level of information seems to have a greater effect on certain forms of school organization. This relationship also seems to be dependent upon what kinds of decisions need to be made. If the choice is to minimize decision making costs, rather than to optimize the use of instructional resources and learning, then instructional information systems may not be as useful. However, if better management of instruction is an important goal for schools to pursue, than instructional information systems and different forms of organization could help.

Some teacher opposition to instructional information systems is articulated in arguments similar to those of critics of criterion referenced testing. Test construction, application, scoring, grading, interpretation, and prescription are time consuming tasks, and teachers do not want to commit time to them unless there is a distinct benefit to teaching.

A major problem with an instructional information system is deciding how much information to collect, what types of information to collect, and how to collect the information in a convenient form. The goal of the IIS is to provide sufficient information to make appropriate instructional decisions, but not to collect so much that the system is drowning in unused information. Collecting information is work and takes time. Unless it is used, teachers will soon lose faith in the system and take steps to eliminate it. The type of information to collect is also a concern. Too often testing focuses on the easy to measure, concrete cognitive tasks and neglects the higher order tasks, which, in terms of instructional approach, may be much more important for student learning. Methods of input, such as optically scanned objective tests, tend to influence the types of information that are collected. Significant effort must be made to develop methods of input that can conveniently measure higher level skills. Again, use of staff time is a major consideration and a major component of the credibility of an instructional information system.

The data in an instructional information sysytem is meant to be one additional resource for teachers to use in making instructional decisions. It is not meant to replace teacher judgment or to "second guess" teachers. Unfortunately, there is a danger that teachers will rely on this information as the determining factor to make a decision whether a student has mastered a particular skill. The implementation of an

instructional information system requires that teachers receive training in the limits and role of data in decision making.

An additional concern that teachers and others have articulated is that instructional information systems "objectify" the curriculum and cause attention to be directed to certain parts of schooling to the neglect of other. Many teachers believe that teaching and learning are predominantly affective activities and that cognitive activities are a minor concern. When IIS's are introduced, the hard-to-measure affective skills will receive less emphasis and be devalued. This reduces the ability to adapt instruction to individual learning and teaching styles. Teachers are also concerned that a set of objective data will replace more "human" perceptions of students. They hold that results from objective assessments distort perceptions of students.

Others believe that learning cannot be measured and recorded or that learning should not be judged according to discrete quantitative measures. The instructional information system does not measure intellectual growth, creativity, or personal growth. It accentuates the memorization of trivia and concrete cognitive skills. Learning is predominantly a social activity and is interpreted through the social content of schooling rather than a reified, objective measure. Still others argue that choice is essential for learning, and a computerized system limits choices and rewards blind obedience.

IV. CONCLUSIONS

Although most districts routinely collect much pertinent data for school improvement efforts, these data are seldom integrated into a system where access is easy or analyzed and reported in a manner consistent with extant knowledge about the possibilities and limits of information. Few schools collect and interpret data for this purpose and those that do, do so on a more informal basis. To increase systematic collection and use of information, it so should require little time and money. The only other possibility is to make it so compelling in terms of how teachers and principals define their work that they will be willing to reallocate existing resources to that effort. The most prevalent advance in this area has been some of the simple computer managed instruction systems now being developed by some of the testing companies. They have several advantages:

1. They are analytically simple. They require no more analytic knowledge than the ability to interpret percent of items correct and to distinquish whether or not a student has scored above or below a mastery level on that information.

2. They are congruent with the textbook and therefore, the curriculum and instruction. The information matches what the teacher has taught from the textbook, can be interpreted clinically, and action (prescriptions) can be taken to remedy any problems discovered.

3. They require relatively simple technology. Most of them require an Apple or IBM-PC computer with inexpensive card readers. Although these systems require an outlay of a couple of thousand dollars, it is within the reach of most schools, since that same technology can perform dozens of other chores.

4. The teacher is willing to invest the time to learn and to actually use the system because it frees the teacher from time consuming chores of test scoring and record keeping.

5. They are convenient to use and inexpensive so that they can be

made available to the teachers in each building or even in each classroom.

6. There is a sense of ownership and control by teacher over the process and the use of and access to the data.

Although the micro computer systems are limited and do not have all of the potential of an instructional information system on a larger machine, it does move in the direction of achieving some of its goals. It requires teachers to teach to objectives, to set goals and expectations about their teaching and to be accountable (mainly to themselves) for results. Conceivably, the information in these systems could be aggregated for use at a building or district level for further analysis.

The major disadvantage to such small micro computer systems is that the data is only available for a few decisions in one location. A principal might want use of that data for building level decisions or a district administrator might need that information for a program evaluation. The information is not easily integrated or aggregated for a multilevel analysis. These systems are also limited in speed, flexibility and control. Small micro computers are effective for small projects, but if you attempt to implement some of the more sophisticated functions of instructional information systems as proposed here, they will be inadequate for the task. The software in these systems is usually written for one curriculum, which means you have different software for math, reading, language arts and no software for other curriculum areas. If you wish to deviate from the curriculum, the software limits the

changes that can be made. Also, micro computers are not easily set up to down-load from district level computers which might contain other information on students which could be useful for instructional decision making.

In order to justify the increased costs of IIS's, significant benefits must be brought to the instructional process by the implementation of an IIS. IIS's alone will not bring significantly greater achievement and learning. They will however, make those improvements to the instructional process more feasible. Many of the benefits of IIS are higher order benefits, to be realized only after the system is in place, is completely operational and integrated, and the personnel are trained to realize and act upon better information.

Instructional information systems, by their essential nature, are comprised of systematically collected, relatively objective data. As such, they are comprised of the types of information teachers have the least experience in using. Primarily, this is because such information is not available to teachers in a usable format. An instructional information system, designed to support the prescriptive planning model, could move teaching closer to the model by providing some of the functions of the model.

If we assume that the technical problems of putting together an instructional information system can be overcome, does that mean that teachers would automatically use the information for instructional decision making? The answer is probably no.

The major goals for implementing an instructional information system are:

1. The perceived benefits to the instructional process brought by an instructional information system must be significantly greater than the perceived costs of time and commitment on the part of teachers.

2. The information system must be highly integrated into the instructional process and work effectively if it is to have any credibility.

3. Teachers, principals, and other professional staff must be closely involved in the decision making, development, use, and evaluation of the system.[11]

4. Adequate support, in terms of documentation, initial training, refresher courses, software updates, prompt response to problems and continued system development, must be provided to users of the system.

5. There must be widespread support for, and acceptance of, the instructional delivery model that the information system would support.

6. The system must be flexible in order to meet teachers' information needs, even though they violate a particular instructional approach. Information in the system should be applicable to a wide variety of teacher needs and practices.

7. Fears about lack of teacher control over the information and concerns for an over accentuation on accountability can be overcome by a climate of trust and shared responsibility.

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[11]Kenneth A. Sirotnik, "Using vs Being Used by School Information Systems." Paper presented at the 1984 Annual Meeting of the American Educational Research Association, New Orleans, La., April 23-27, 1984.

8. The system must be easy to use. It must possess all of the modern "user friendly" capabilities of good software. It should be designed to be operated by a teacher or a teacher's aide with a minimum amount of training. The system should be menu driven with choices clearly labeled. It must be simple enough to encourage different people to fully use the system.

9. Reports from testing or other data input should be returned to teachers in a very short period of time. The instructional process is time sensitive. Teaching must go on and the limited amount of time available for it must be utilized to its fullest, regardless of whether new information about student progress is available. In order to have a significant impact on everyday teaching, information such as test scores and their implications must be available in a very short period of time.

10. The system should link with other data bases. The system should have the capability of being linked to larger school data bases. Some school systems keep information on students in a system which is distinct from the instructional management system. The capacity to link to external data bases is important for ease of maintaining student files.

11. The user ought to be able to control the types and formats of reports printed by that system. The system ought to produce reports for individual students over a specific time period, and reports of each class, grade, instructional group, and school or district.

In all probability, we will need to build IIs's which support existing practices, will change practices to better utilize information, and will focus on instructional practices which have demonstrated ability to improve and aid instruction and which make IIS's much more feasible.

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